

Ser. No. 10/517,802

### Amendments to the Claims

1. (Currently amended) A safety system for use with a machine having a moving part arranged to move through a known path of movement, the safety system characterised by comprising:

at least one light emitting means arranged at one end of the part to emit light, the axis of the emitted light being aligned to illuminate a region including at least a portion of said path of movement;

at least one light receiving means arranged at an opposite end of the part to receive light from one or more of the light emitting means which has passed through said region; and

a processing and control means arranged to receive information from the light receiving means and thereby recognise the presence of one or more shadowed regions within the vertical and horizontal extents of said illuminated region on the light receiving means cast by obstructions in the region;

wherein the illumination of the region is such that the processing and control means has sufficient information to determine boundaries of the or each shadowed region and control movement of the part dependent on said information.

2. (Original) A safety system in accordance with claim 1, characterised in that the processing and control means either slows or stops the movement of the part if the processing and control means determines the presence of an obstruction in a predetermined or calculated area of the region.

3. (Previously presented) A safety system in accordance with claim 1, characterised in that the processing and control means calculates the positions of the obstructions relative to the part or relative to each other and slows or stops the part dependent on the relative positions.

4. (Previously presented) A safety system in accordance with claim 1, characterised in that the processing and control means calculates the speeds of movement of the obstructions relative to the part or relative to each other and slows or stops the part dependent on the relative speeds.

Ser. No. 10/517,802

5. (Previously presented) A safety system in accordance with claim 1, characterised in that the region is large with respect to the size of a leading edge of the part and is entirely illuminated by a single parallel beam of light.

6. (Previously presented) A safety system in accordance with claim 1, characterised in that the region is large with respect to the size of a leading edge of the part and is illuminated by an array of individual light beams.

7. (Previously presented) A safety system in accordance with claim 1, characterised in that the light receiving means is provided with an aperture to reject received light that is not parallel to the axis of the emitted light.

8. (Previously presented) A safety system in accordance with claim 1, characterised in that an input means is provided such that when the processing and control means slows or stops the movement of the part, actuation of the input means by the operator informs the processing and control means that continued movement of the part is safe and the processing and control means resumes movement of the part.

9. (Original) A safety system in accordance with claim 8, characterised in that when the processing and control means is informed that continued movement is safe, the processing and control means stores in a memory means one or more maps made up of image information received by the light receiving means as the part moves through the path of movement.

10. (Original) A safety system in accordance with claim 9, characterised in that the processing and control means compares the current image received by the light receiving means to the maps stored in the memory means and allows continued operation of the part if sufficiently similar.

11. (Previously presented) A safety system in accordance with claim 9, characterised in that the processing and control means compares the current image map being created as the part moves

Ser. No. 10/517,802

through the path of movement to the maps stored in the memory means and allows continued operation of the part if sufficiently similar.

12. (Previously presented) A safety system in accordance with claim 1, characterised in that a part position detector is provided to detect the position of the part relative to the machine, the part position detector being arranged to provide information regarding the part position to the processing and control means.

13. (Previously presented) A safety system in accordance with claim 1, wherein the processing and control means is arranged to determine the vertical distance between a forward edge of the part and an obstruction casting a shadow on the light receiving means and allows continued movement of the part if the distance determined is greater than a predetermined distance required to safely stop the part.

14. (Currently amended) A safety system in accordance with claim 1, characterised in that the processing and control means is arranged to determine the thickness of an obstruction casting a shadow on the light receiving means and allow continued movement of the part should the thickness be less than a predetermined value, the predetermined value being a value determined to be small enough that the obstruction could not be a part finger of the operator's body.

15. (Previously presented) A safety system in accordance with claim 1, characterised in that the light receiving means provides image information to the processing and control means and utilises a high shutter speed to give a strobe effect.

16. (Previously presented) A safety system in accordance with claim 1, characterised in that the light receiving means provides image information to the processing and control means and the light emitting means is flashed to create stroboscopic images of the obstruction.

Ser. No. 10/517,802

17. (Previously presented) A safety system in accordance with claim 16, characterised in that the processing and control means uses interpolation to determine the position of obstructions between samples.

18. (Previously presented) A safety system in accordance with claim 16, characterised in that the processing and control means uses interpolation to estimate the position of obstructions at some time in the future.

19. (Previously presented) A safety system in accordance with claim 16, characterised in that said flashing of the light emitting means is alternation between an on state in which the light emitting means emits light and a dim state in which the intensity of the light emitted by the light emitting means is reduced relative to the on state.

20. (Previously presented) A safety system in accordance with claim 1, characterised in that the light receiving means includes a charge coupled device.

21. (Previously presented) A safety system in accordance with claim 1, characterised in that the light receiving means comprises a projection screen and image information is detected by a camera arranged to observe the image on the projection screen.

22. (Previously presented) A safety system in accordance with claim 1, characterised in that the light receiving means and the light emitting means are mounted to be stationary relative to the part.

23. (Previously presented) A safety system in accordance with claim 1, characterised in that the light receiving means and the light emitting means are mounted stationary relative to the machine having the moving part.

24. (Previously presented) A safety system in accordance with claim 1, characterised in that one or more shadow mask is provided and the processing and control means is arranged to recognise

Ser. No. 10/517,802

the shadow created by the shadow mask on the light receiving means and use this information to determine that the light receiving means is functioning correctly.

25. (Original) A safety system in accordance with claim 24, characterised in that the processing and control means is arranged to recognise the shadow created by the shadow mask on the light emitting means and use this information to determine if the safety system is in correct alignment.

26. (Previously presented) A safety system in accordance with claim 25 or 53, characterised in that a shadow mask is provided and the processing and control means is arranged to detect alignment of the system and thereby compensate for misalignments.

27. (Previously presented) A safety system in accordance with claim 1, characterised in that a display device is provided to display the images received by the light receiving means.

28. (Previously presented) A safety system in accordance with claim 1, characterised in that the light emitting means includes one or more lasers as a light source.

29. (Previously presented) A safety system in accordance with claim 1, characterised in that the light emitting means includes one or more laser diodes as a light source.

30. (Previously presented) A safety system in accordance with claim 1, characterised in that the light emitting means includes a transmitting end lens arrangement including one or more transmitting end lenses such that light is directed by the transmitting end lens arrangement through the region.

31. (Original) A safety system in accordance with claim 30, characterised in that the transmitting end lens arrangement includes one or more concave lenses to expand the light beam.

32. (Previously presented) A safety system in accordance with claim 31, characterised in that the transmitting end lens arrangement includes a transmitting end spherical ball to focus the light.

Ser. No. 10/517,802

33. (Previously presented) A safety system in accordance with claim 30, characterised in that the light is focussed through a pinhole.

34. (Previously presented) A safety system in accordance with claim 30, characterised in that the transmitting end lens arrangement includes an aspheric lens arranged to columnate the light.

35. (Previously presented) A safety system in accordance with claim 30, characterised in that the transmitting end lens arrangement includes a lens to correct for spherical aberration such that columnated light is directed through the region.

36. (Previously presented) A safety system in accordance with claim 1, characterised in that the light emitting means includes a transmitting end reflector, the axis of the emitted light being transmitted off axis relative to the light passing through the region.

37. (Previously presented) A safety system in accordance with claim 36, characterised in that the reflector is an off-axis parabolic reflector.

38. (Previously presented) A safety system in accordance with claim 1, characterised in that the light receiving means includes a receiving end lens arrangement such that light passing through the region is focussed by the receiving end lens arrangement.

39. (Previously presented) A safety system in accordance with claim 38, characterised in that the receiving end lens arrangement includes a lens to correct for spherical aberration.

40. (Previously presented) A safety system in accordance with claim 38, characterised in the focussed light from the receiving end lens arrangement passes through one or more apertures.

41. (Previously presented) A safety system in accordance with claim 38, characterised in that the receiving end lens arrangement includes an aspheric lens.

Ser. No. 10/517,802

42. (Previously presented) A safety system in accordance with claim 1, characterised in that the light receiving means includes a receiving end reflector, the receiving end reflector arranged to reflect light which has passed through the region toward the or each light receiving means.

43. (Original) A safety system in accordance with claim 42, characterised in that the reflector is an off-axis parabolic reflector.

44. (Previously presented) A safety system in accordance with claim 1, characterised in that the machine is a bending machine and the moving part is a tool of the machine.

45. (Previously presented) A safety system in accordance with claim 1, characterised in that the machine is a bending machine and the moving part is an anvil of the machine.

46. (Currently amended) A safety system in accordance with claim 44 or 45, characterised in that the moving part is arranged to bend material and the processing and control means controls movement of the ~~tool~~ moving part during bending.

47. (Previously presented) A safety system in accordance with claim 46, characterised in that the movement of the part during bending is slowed or stopped if the image received by the light receiving means is inconsistent with pre-stored or calculated images of material being bent in the same manner.

48. (Currently amended) A safety system for use with a machine having a moving part arranged to move through a known path of movement, the safety system comprising:

light emitting means at one end of the part for emitting light so as to illuminate a region including at least a portion of said path;

light receiving means at an opposite end of the part for receiving the emitted light; and  
a processing and control means for receiving image information from the light receiving means and recognising the presence of a shadowed region within the vertical and

Ser. No. 10/517,802

horizontal extents of said illuminated region on the light receiving means cast by an obstruction in the region, determining a boundary of the shadowed region, and controlling movement of the part responsive to the image information.

49. (Currently amended) A safety system for use with a machine having a moving part arranged to move through a known path of movement, the safety system comprising:

- at least one light source positioned at one end of the part to emit light so as to illuminate a region including at least a portion of said path;
- at least one light detector positioned at an opposite end of the part to receive a portion of the emitted light which has passed through said region; and
- a processor, coupled to the light detector to receive image information from the light detector and programmed to recognise the presence of at least one shadowed region within the vertical and horizontal extents of said illuminated region on the light receiving means cast by at least one obstruction in the region, determine at least one boundary of the at least one shadowed region, and control movement of the part.

50. (Currently amended) A machine comprising:

- an anvil;
- a work item on the anvil;
- a moving part arranged to move through a known path of movement toward the work item to strike the work item;
- at least one light source positioned at one end of the part to emit light so as to illuminate a region including at least a portion of said path;
- at least one light detector positioned at an opposite end of the part to receive a portion of the emitted light which has passed through said region; and
- a processor, coupled to the light detector to receive image information from the light detector and programmed to recognise the presence of at least one shadowed region within the vertical and horizontal extents of said illuminated region on the light receiving means cast by at least one obstruction in the region, determine at least one boundary of the at least one shadowed region, and control movement of the part.

Ser. No. 10/517,802

51. (Currently amended) A method for operating a machine, the machine having a moving part, the method comprising:

moving the moving part along a known path of movement;  
emitting light at one end of the part to illuminate a region including at least a portion of said path;  
receiving a portion of the light at an opposite end of the part which has passed through said region;  
recognising the presence of a shadow within the vertical and horizontal extents of said illuminated region cast by an obstruction in the region;  
determining a boundary of the shadow; and  
controlling movement of the part responsive to a property of the shadow.

52. (Previously presented) The method of claim 51 wherein:

the controlling comprises at least one of slowing, stopping, and reversing the movement responsive to the presence of the obstruction; and  
the movement is toward a work to strike the work.

53. (Currently amended) A safety device in accordance with claim 1, characterised in that ~~the a~~ receiving size of the illuminated region is smaller than ~~the an~~ image detection device of the light receiving means and the position of the image on the image detection device is used to determine misalignment.

54. (Previously presented) A safety system in accordance with claim 1, characterised in that the part is a tool, the tool is arranged to bend material and the processing and control means controls movement of the tool during bending.

55. (Currently amended) A system, for use with a machine having a moving part arranged to move through a known path of movement, the system characterized by comprising:

Ser. No. 10/517,802

at least one light emitting means arranged at one end of the part to emit light, the axis of the emitted light being aligned to illuminate a region including at least a portion of said path of movement;

at least one light receiving means arranged at an opposite end of the part to receive light from one or more of the light emitting means which has passed through said region; and

a processing and control means arranged to receive information from the light receiving means and thereby recognize the presence of one or more shadowed regions within the vertical and horizontal extents of said illuminated region on the light receiving means cast by obstructions in the region;

wherein the processing and control means processes said information received from the region and controls the part dependent on said processed information.

56. (Previously presented) A system according to claim 55, characterized in that the processing and control means saves information received from the region and controls the part dependent on said saved information.

57. (Previously presented) A system according to claim 55, characterized in that the processing and control means controls the part dependent on the shapes and/or positions of the shadowed regions.

58. (Previously presented) A system according to claim 55, characterized in that machine is used for bending material and the processing and control means analyses information from the region during bending and controls the part dependent on said analysis.

59. (Previously presented) A system according to any one of claims 55 to 58, characterized in that light emitting or receiving means includes a reflector, the axis of the emitted light or received light being transmitted off axis or received off axis relative to the light passing through the region.